

What is claimed is:

1. A system for moving an aerial vehicle along a flight path, said system comprising:

5 a substantially disk-shaped hub mounted on the vehicle for rotation about a hub axis, with said hub lying in a plane substantially perpendicular to the hub axis;

an airfoil shaped blade positioned on said hub for rotation therewith, wherein said blade travels on a blade path around the hub axis during rotation of said hub, said blade defining a blade axis and a chord line;

10 a gear assembly changeable between a first modality (curtate flight) wherein the chord line of said blade is maintained generally tangential to the blade path during rotation of said hub, and a second modality (prolate flight) wherein the chord line of said blade is maintained generally parallel to the flight path of the vehicle during rotation of said hub; and

15 a means for rotating the chord line of said blade about said blade axis to alter the angle of attack of said blade and generate forces for moving the vehicle along the flight path.

20 2. A system as recited in claim 1 wherein said gear assembly comprises:

a blade gear, with said blade fixedly attached thereto, said blade gear being mounted on said hub for rotation around the blade axis and for rotation with said blade around the hub axis;

25 a center gear oriented on said hub for rotation around a center gear axis with the center gear axis substantially parallel to the hub axis; and

a mid-gear rotationally interconnecting said blade gear with said center gear.

3. A system as recited in claim 2 further comprising:
a first link having a first end and a second end with the first end thereof pivotally mounted on said blade gear and the second end thereof pivotally mounted on said mid-gear; and
5 a second link having a first end and a second end with the first end thereof pivotally mounted on said mid-gear and the second end thereof pivotally mounted on said center gear.

4. A system as recited in claim 3 wherein said chord line rotating means comprises a means for moving the center gear to vary a distance
10 between the center gear axis and the blade axis.

5. A system as recited in claim 4 wherein said center gear has a diameter and the center gear axis is moveable within a radial range from the hub axis between a location wherein the center gear axis is coaxial with the hub axis and a location wherein the center gear axis is approximately at a one
15 half center gear diameter from the hub axis.

6. A system as recited in claim 2 wherein the blade axis is substantially perpendicular to the chord line, and wherein the blade axis is substantially parallel to the hub axis during rotation of said blade on the blade path around the hub axis.

20 7. A system as recited in claim 2 further comprising a means for selectively holding said center gear stationary relative to said hub axis to establish said gearing means in the second modality.

8. A system as recited in claim 2 further comprising a means for holding said hub stationary relative to the vehicle to change said gear
25 assembly into a third modality (fixed wing flight).

9. A system as recited in claim 8 wherein said chord line rotating means comprises a means for rotating said center gear while said gear assembly is in the third modality.

10. A system as recited in claim 2 wherein said blade, said blade gear, and said mid-gear, in combination, comprise a blade orientation unit and said system comprises:

a plurality of said blade orientation units; and

a plurality of center gears with each said center gear connected to a respective blade orientation unit.

11. A cycloidal propulsion and control system for moving an aerial vehicle along a flight path which comprises:

a first hub and a second hub, said first and second hubs being respectively mounted on the vehicle for rotation about a common hub axis;

a first plurality of elongated airfoil blades defining respective chord lines and mounted on said first hub substantially parallel to the hub axis for rotation about the hub axis;

a second plurality of elongated airfoil blades defining respective chord lines and mounted on said second hub substantially parallel to the hub axis for rotation about the hub axis; and

a means for individually and selectively varying an orientation for each chord line of each said airfoil blade for propelling and controlling the vehicle while the vehicle is on the flight path.

12. A system as recited in claim 11 wherein each rotating airfoil blade travels on a blade path around the hub axis and wherein said varying means comprises a gear assembly changeable between a first modality (curtate flight) wherein the chord line of said blade is maintained generally tangential to the blade path during rotation of said hub, and a second modality (prolate flight) wherein the chord line of said blade is maintained generally parallel to the flight path of the vehicle during rotation of said hub.

13. A system as recited in claim 12 wherein each airfoil blade defines a blade axis and wherein said gear assembly comprises:

10 a blade gear, with said airfoil blade fixedly attached thereto, said blade gear being mounted on said hub for rotation around the blade axis and for rotation with said blade around the hub axis;

a center gear oriented on said hub for rotation around a center gear axis with the center gear axis substantially parallel to the hub axis;

15 and

a mid-gear rotationally interconnecting said blade gear with said center gear.

14. A system as recited in claim 13 wherein three gear assemblies are mounted on each said hub.

20 15. A system as recited in claim 14 wherein each center gear has a respective start point for establishing a same orientation for the chord line of each airfoil blade at a predetermined point on the blade path.

16. A system as recited in claim 15 wherein said respective start points of said three center gears are mutually off-set from each other by an arc of 120° (curtate mode).

25

17. A system as recited in claim 15 wherein said respective start points of said three center gears are substantially aligned with each other (prolate mode).

18. A method for moving an aerial vehicle along a flight path which
5 comprises the steps of:

mounting a first plurality of elongated airfoil blades on a first hub, wherein each airfoil blade defines a chord line and is mounted on said first hub substantially parallel to a hub axis of rotation;

10 mounting a second plurality of elongated airfoil blades on a second hub, wherein each airfoil blade defines a chord line and is mounted on said second hub substantially parallel to the hub axis of rotation;

selectively rotating the first and second plurality of airfoil blades about the hub axis; and

15 individually and selectively varying an orientation for each chord line of each said airfoil blade for propelling and controlling the vehicle while the vehicle is on the flight path.

19. A method as recited in claim 18 wherein each rotating airfoil blade travels on a blade path around the hub axis and wherein said varying
20 step involves changing between a first modality (curtate flight) wherein the chord line of said blade is maintained generally tangential to the blade path during rotation of said hub, and a second modality (prolate flight) wherein the chord line of said blade is maintained generally parallel to the flight path of the vehicle during rotation of said hub.

25 20. A method as recited in claim 19 further comprising the step of holding said hub stationary relative to the vehicle to change said gear assembly into a third modality (fixed wing flight).